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INVESTIGATIONS ON FORAGE YIELD OF OAT GENOTYTPES UNDER IRRIGATED CONDITIONS OF KONYA

Sait Ceri[1] and Ramazan Acar[2]

[1]Bahri Dagdas Uluslararasi Tarimsal Arastirma Enstitusu, Konya, Turkey; [2]Selcuk Universitesi Ziraat Fakultesi Tarla Bitkileri Bolumu, Konya, Turkey
[*]Corresponding author's e-mail: sait.ceri@tarimorman.gov.tr

Oat is an important cereal as human food and animal feed. This research was aimed to evaluate some oat genotypes (lines and cultivars) for forage yield and forage quality parameters. Research was carried out in Konya irrigated conditions, in Spring 2018 with 12 oat genotypes [nine lines (BDY-1, BDY-2, BDY-3, BDY-4, BDY-5, BDY-6, BDY-7, BDY-8, BDY-9) and three were registered cultivars (Dirilis, Cheocota, Seydisehir)]. The trial was established according to the Randomized Blocks Experimental Design with three replications. Oats genotypes were harvested at milk to dough period.
The traits such as days to heading(68-85 days), green forage yield (23420-31090 kg ha^{-1}), dry forage yield **(**6140- 9940 kg ha^{-1}), plant height, (80-109 cm.), the number of stems per square meter (453.33-677.33 pieces), the number of fertil stems per square meter (133.33-450.83 pieces), fertile cluster ratio (28.22-80.57%), the number of node per stems, (3.73 -4.77 pieces), stem thickness (3.68-5.62 mm), 10 stem weight (68.52-133.46 g), leaves weight (13.02-35.06 g), leaf stem ratio (14- 27 %), cluster (panicle)) length (17.48-22.72 cm), flag leaf length (14.63-23.90 cm) and the number of leaves per stems (4.07-4.87 pieces) were investigated.
Keywords: *Avena sativa* L., cereal, genotypes, animal feed, green forage, Yield, Yield components.

INTRODUCTION

Oat (*Avena sativa* L.) is an important cereal plant grown as a cultivated plant and used in both human and animal nutrition. In recent years, the increasing importance of oats in human nutrition in the world and its use in industry has led to an increase in production area. Besides being animal feed and human food; It has gained importance especially in recent years due to the increase in usage areas in the pharmaceutical and cosmetic industry (Çeri and Acar, 2019a). Turkey has a potential in the world in terms of the number of animals. However, in terms of animal feed production and consumption, Turkey is insufficient compared to the developed world. The area of oat planted for green forage in Turkey was 82.551, 80.364, 82.628, 82.589, 86.790, 106.356 and 214.257 hectares in 2012, 2013, 2014, 2015, 2016, 2017 and 2018, respectively, whereas the green forage production in the same years was 934.157, 1.088.168, 1.156.553, 1.180.294, 1.549.846, 1.755.323 and 2.843.686 tons, respectively (Çeri and Acar, 2019b)

Quality roughage production plays a key role in the development of the forage crops and livestock industry. In addition, feed and feeding costs, which cover a large part of 60-70% during the production stage in the livestock industry, significantly affect the profitability of the enterprise. One of the quality roughage sources is forage plants (Özkan and Şahin Demirbağ, 2016). In order to increase animal production, inexpensive and easily available feed sources are required by the producers. Of these sources, oats are an important alternative herb. Oat is a priority product as animal food in the world, and it is inevitable to increase its production in our country, considering the importance of oats in animal nutrition (Sayar, 2017).

In this research article the forage yield and some forage yield components of some oat varieties and lines in Konya irrigated conditions are investigated.

MATERIALS AND METHODS

The field study was conducted at the Bahri Dağdaş International Agricultural Research Institute (BDIARI) in Konya in irrigated conditions during the early spring growing season of 2018. The experimental design of this research was a randomized complete block design (RCBD) with factorial arrangement and three replications of the

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selected 12 oat genotypes, which were nine lines and three cultivars (Table 1).

BDY-1, BDY-2, BDY-3, BDY-4, BDY-5, BDY-6, BDY-7, BDY-8, BDY-9 lines were provided by Bahri Dagdas International Agricultural Research Institute (BDIARI). Diriliş, Cheocota, and Seydişehir varieties were also used as research materials.

Seydişehir oat variety, which released in 2004 by BDIARI, is a local variety and has favorable forage yield and quality traits. Diriliş oat variety, which was released in 2017 by BDIARI, is a desirable oat variety for its grain and forage yield. Cheocota oat variety, released by Eskisehir Transitional Zone Agricultural Research Institute (ETRI), selected for its high-quality traits.

Table 1. Oat genotypes used in the experiment.

G.N.	Pedigree
BDY 1	ND040492(ND970216/Souris)/FL0917F1(OA 1178-2 /FL03184-K9)
BDY 2	FL0105-H3 TX97C1168/IA91462-45-6
BDY 3	BW 803/FL99078-H1
BDY 4	UFRGS 046054-2/MN06120
BDY 5	UFRGS 028153-2 (UFRGS 881971//PC68*5/STARTER F4)/FL0109 - H3 (P94327A2-2-2-3- 3/LA989IBI-42 F4)
BDY 6	UFRGS 046054-2/MN06120
BDY 7	FL0567-L1(UFRGS028152-1/FL0123-H2)/FL0905F1(UPF98H1600-2-1/FL03129- Ab3)
BDY 8	NC03-2421 / LA09094, F1(UFRGS087212-1 / LA04004SBSB-61-B-S1)
BDY 9	UPF97H300-2-12 / ND030349
BDY10	DIRILIS
BDY11	CHEOCOTA
BDY12	SEYDISEHIR

During study period in 2018, the average temperature was higher than many previous years (Table 2). The drougt month of spring was April, with 14.4 mm of precipitation (Table 2). Table 2 also shows the relative humidity rate, which averaged 60.4% in the spring 2018.

During the research period, rainfall, which usually falls in April, was spread over May and the following months due to climate change. Thus, the total amount of precipitation in the spring period (March-June 2018) was 161.4 mm, while it had been a total of 126.8 mm for previous years (Table 2).

Table 2. Average temperature and rainfall in Konya during 1950-2018 and Spring (March-June, 2018) cultivation period.

Months	Temperature (°C)		Rainfall (mm)		Relative humidity (%)
	1950-2018	2018	1950-2018	2018	2018
March	5.5	9.8	26.2	36.0	67.6
April	11.1	13.9	38.8	14.4	52.9
May	15.7	17.2	41.7	72.2	66.9
June	19.9	21.2	20.1	38.8	54.2
Average	13.0	15.5	31.7	40.4	60.4
Total	52.2	62.1	126.8	161.4	241.6

Soil samples of the experimental site were collected from topsoil (0-30 cm depth) and analyzed for defining the physical and chemical properties of the field. The soil analysis illustrated that the soil has a clay-loam structure with medium (1.83%) organic matter, high lime content (31.32%) and alkaline (pH: 8.30) reaction. The soil had a sufficient phosphorus (90 kg ha^{-1}, and potassium (755.3 kg ha^{-1}). Also, the soil analysis results highlight no salinity problem.

Oat seeds were sown on 450 plot/m^2 in irrigated conditions on the 27th of March in 2018. The Plot dimensions of the experiment were 8.4 m^2 (1.2 x 7 m) with six rows and 20 cm spaced apart from each row. The field experiment was irrigated at 3 stages; 1) during the plantation, 2) 2-5 tillering, 3) 2-3 cm stalk height (Zadoks growth scale 30-31). Irrigation was applied after fertilization for six hours. In the experiment, 9 kg da^{-1} P_2O_5 and 12 kg da^{-1} N fertilizer was applied. Weed was controlled by using a chemical (2.4-D Ester, 130 g da^{-1}).

The period between milk and pulp death was highly recommended for the shaping of oats and other cereal grains by Staples (1989). For this reason, trial plots were cut with a reaping-hook during the milk to dough stage. Correlation coefficients among forage growth, grain yield, and other traits were analyzed by the statistics program JMP 11.

Investigated Features

Number of days of heading The date when 50% of the plants in the plot were clustered (Fowler, 2009).

***Green forage yield (kg/da)*:** Green forage yield was determined by the method of Albayrak (2003). Oat genotypes were harvested during the milk and dough death period. The oat forage harvested from 1 m^2 area was weighed and converted to ha and green forage yield was calculated.

***Dry forage yield (kg/da)*:** After weighing the green forage harvested from each plot, 0.5 kg of green forage samples taken randomly were placed on paper bags and dried in a drying cabinet at 70 °C for 48 hours (Ünal, 2011). The samples taken out of the drying cabinet were kept at room temperature for 24 hours and then weighed on an electronic scale with 0.05 g precision in order to determine the dry forage weight. Dry forage yields per hectare were calculated as kg ha^{-1} from the values obtained.

***Plant height (cm)*:** In each plot, 10 plants were randomly selected before harvest for plant height. The plant height was measured in cm from soil level to the top of the main cluster by modifying the method described by Balabanli and Ekiz (1996).

***Number of stems per square meter*:** The method of Tosun and Yurtman (1973) was modified and used to determine the number of stems per square meter. Stems that in (1 m*0.2m) 0.2 m^2 area in each row were counted in each and the number of stems per square meter was calculated by multiplying by 5.

***The number of stems with clusters per square meter*:** The method of Sobayoğlu (2017) was modified and used to determine the number of clustered stems per square meter. Stems in 1 m area in each row were counted and multiplied by 5 in each plot, and the number of clustered stems per m² was worked out.

***Cluster length (cm)*:** In the cluster of 10 plants determined randomly in each plot, the length from the lower node of the cluster to the top of the cluster, excluding the awns, was measured in cm (Yağbasanlar, 1987).

***The Fertile (with cluster) stem ratio* (%):**

The number of stems with clusters per square meter x100)
The number of stem per square meter

***The number of nodes in the stem*:** In each plot, the number of internodes of the plants above the ground level were counted.

***Stem thickness (mm)*:** Randomly selected 10 plants before harvesting in each parcel were removed with roots and the thickness of the main stem between the 2nd and 3rd node was measured with a 0.1 mm compartment caliper and the value obtained was taken as the average main stem thickness (Sayar, 2011).

***Leaf weight on the stem (g)*:** The leaves on the main stem of 10 plants taken from each plot were cut and separated from the bottom of the leaf sheath and weighed in grams (Yürür *et al*., 1981).

***Leaf stem ratio (%)*:** 10 plants were randomly selected from each plot, leaves and stems were separated, weighed and determined (Bares *et al*., 1985).

Formula was used as

(10 Stems of leaves weight **/** 10 Stems weight) x 100

***Flag leaf length (cm)*:** The method of Bares *et al*. (1985) was modified and used to determine the flag leaf length. 10 plants were selected from each parcel, the length of the flag leaf was measured in cm.

***The number of leaves on the stem*:** The leaves on the main stem of 10 plants taken from each plot were counted and expressed as average leaf number (Yürür *et al*., 1981).

The findings obtained as a result of the study were subjected to variance analysis with the help of the JMP (11) statistical package program in accordance with the Trial Pattern of Random Blocks with three repetitions. According to the results of variance analysis, statistically significant factor averages were compared with the LSD test (Kalayci, 2005).

RESULTS AND DISCUSSION

***Number of days of Heading*:** The number of days of heading in oat genotypes ranged 68-85 days (Table 3). According to this, the earliest lines were BDY-1 and BDY-3 (68 days); Cheocota has been 70 days. The lines with delayed heading were BDY-5 (78 days) and BDY-6 (78 days); whereas the late variety was Seydişehir (85 days). In studies on a similar feature, Gül *et al*. (1999) reported 116.2-129.5 days to heading; while Yağbasanlar *et al*. (1990) determined 116-122 days. It was determined that the values we obtained are lower. This may have resulted due to different genotypes, environmental conditions, applied

Table 3. Comparison of oat genotypes for forage yield under irrigated conditions.

Genotypes	HD (day)	GFY (kg ha^{-1})	DFY (kg ha^{-1})	PH (cm)	M^2 NS (No. m^{-2})	M^2 NFS (No. m^{-2})	FSR (%)
BDY-1	68	27.46abc	7.07c-f	108.00a	477.50c	385.00ab	80.57a
BDY-2	73	24.19bc	6.14f	100.00a-d	604.17ab	357.50abc	59.19bc
BDY-3	68	24.07bc	7.54bde	98.00bde	586.67ab	450.83a	77.40a
BDY-4	72	27.83abc	9.94a	100.00abc	605.00ab	400.83ab	66.31ab
BDY-5	78	23.77bc	6.94def	91.00de	453.33c	133.33f	29.77e
BDY-6	78	24.21bc	6.83def	91.00cde	468.33c	286.67cde	60.90bc
BDY-7	76	31.09a	8.46bc	109.00a	475.00c	287.50cde	59.79bc
BDY-8	74	29.00ab	8.81ab	95.00bde	541.67bc	217.50def	40.22de
BDY-9	70	24.38bc	7.88bd	102.00ab	509.17bc	277.50cde	54.81bcd
Diriliş	72	23.42c	8.10bd	80.00f	465.83c	307.50bcd	65.59abc
Cheocota	70	28.46abc	8.87ab	108.00a	537.50bc	270.83cde	50.46cd
Seydişehir	85	30.25a	6.27ef	90.00e	677.33a	190.83ef	28.22e
Average	74	26.51	774.00	97.60	533.46	296.74	56.10
CV $_{(\%)}$		12.00	11.00	5.82	10.70	19.50	15.96
LSD$_{(0.05)}$		5.44	1.39	9.63	92.29	98.02	15.16
	-	*	**	**	**	**	**

(*); P< 0.05 ; (**); P< 0.01 ; HD: days to heading; GFY: green forage yield; DFY: dry forage yield; PH: plant height; M^2 NS: the number of stems per square meter; M^2 NFS: the number of fertil stems per square meter; FCR: fertile stem ratio

cultural processes or planting time.

***Green forage yield (kg ha^{-1})*:** The green forage yield of the oat genotypes used in the study was statistically significant at the level of 5% ($p<0.05$). The green forage yield of the oat genotypes used in the study varied between 23.420-31.090 kg ha^{-1}, the average green forage yield was 26.510 kg ha^{-1} (Table 3). There were statistically different groups in the oat genotypes used in the study in terms of green forage yield. Accordingly, the first group from the lines BDY-7 (31.090 kg ha^{-1}), while Seydişehir (30.250 kg ha^{-1}), one of the varieties in the same group, was formed and the last group was Diriliş (23.420 kgha^{-1}) regarding green fodder yield.

The green grass yield of 26.510 kg ha^{-1} was produced by Acar and Özkaynak (2000) obtained 1.491.8 kg ha^{-1} and Nawaz *et al*. (2004) 14.160 kg ha^{-1} green fodder yield. On the other hand, the average value of 26.510 kg ha^{-1} in this study variedby Lithourgidis *et al*. (2006) average yield (3.323 kg ha^{-1}) and Avci (2017) winter crop (55.650 kg ha^{-1}) and and summer crop (37.390 kg ha^{-1}); wheras Kara (2017) recorded 34.886 kg ha^{-1} green fodder.

***Dry forage yield (kg ha^{-1})*:** The dry forage yields of the oat genotypes were statistically significant at the level of 1% ($p<0.01$). The hay yield of the oat genotypes varied between 6.140-9.940 kg ha^{-1}, the average dry forage yield was 7.740 kg ha^{-1} (Table 3). Accordingly, BDY-4 (9.940 kg ha^{-1}) from genotypes formed the first group (a) alone. In the genotypes, the last group (f) formed BDY-2 (6.140 kg ha^{-1}).

Acar and Özkaynak (2000) recorded hay yield 1.223.1 kg ha^{-1} from oats; while Kara (2017) Caballero *et al*. (1995), Carr *et al*. (2004) and Nawaz *et al*. (2004) obtianed the dry matter yield of oats (5.761.4 kg ha^{-1}, 6.570 kg ha^{-1}, 2.910 kg ha^{-1} and 1.900 kg ha^{-1}, respectively).*et al*, *et al* Avci (2017) determined an average dry forage yield of 6.884 kg ha^{-1} from summer cultivation. According to our results, the hay yields obtained were higher than the results of these researchers. On the other hand, the hay yield of 7.740 kg ha^{-1} found by Lithourgidis *et al*. (2006) was (11.620 kg ha^{-1}) and Avci (2017) was high obtained in winter planting (12.629.3 kg ha^{-1}). The difference in hay yield may be because of genotypes, environmental conditions, applied cultural practices and planting times.

***Plant height (cm)*:** The difference between varieties in terms of plant height of oat genotypes was found statistically significant ($p<0.01$) and grouped separately (Table 3).

Accordingly, the first group was comprised of lines BDY-1 (108 cm) and BD-7 (108.7 cm), while Cheocota (107.9 cm) entered the same group, and the last group was Diriliş (79.6 cm.). The lines and varieties studied in the experiment were listed between these two groups. Nawaz *et al*. (2004) also reported that the plant height was significantly different in all varieties. While the plant height of the oat genotypes used in our study varied 79.6 cm-108.7 cm and average plant height was 97.6 cm, which was higher than reports. Acar (1995) in his studies determined the average plant height as 67.11 cm. Avci (2017) determined the plant height in oat genotypes as 54.09 cm in summer planting. Similarly Gul *et al*. (1999) and Erbas (2012) recorded plant height in oat genotypes as 79.98-103.60 cm and 66.0-109.2 cm. In terms of plant height in the oat genotypes, Avci (2017) determined average values of 139.52 cm in winter cultivation and 108.78 cm by Kara (2017), which is higher than 97.6 cm that we found in our study. The differential results may be because of different genotypes, environmental conditions, applied cultural processes or planting time.

***Number of stems per square meter*:** The difference between the varieties in terms of stem number per square meter was found to be statistically significant ($p<0.01$). The lines BDY-2 (604.17 stem/m^2), BDY-3 (586.67 stem/m^2) and BDY-4 (605 stem/m^2) were included in the same group. Only Seydişehir variety produced significantly higher stems (677.33 stem/m^2). Among the varieties, the lowest value (465.83 stem/m^2) was recorded in Diriliş. The average number of stems of oat genotypes was 533.46 per square meter and ranged 453.33-677.33 stem/m^2 (Table 3).

Narlıoğlu (2016) observed the low number of 362 stems per square meter than reorded in this research (533.46 stem/m^2). Sobayoğlu (2017) studied a range of 430-532.5 stem/m^2 with average 475 stem/m^2. Hisir (2009) counted 502.00 - 665.25 stem/m^2 which were similar to our research studies. Peltonen-Sainio and Järvinen (1995) stated that the number of stems per square meter should be evaluated together with other characteristics, not alone. The variation in values can be dependent on different genotypes, environmental conditions, applied cultural processes and planting time.

***Cluster (Panicle) length (cm)*:** The difference between the genotypes in terms of cluster length was found to be statistically significant ($p<0.01$). The lines BDY-7 (22.70 cm) and Cheocota (22.72 cm) grouped with the highest value, while the cultivars Diriliş had the lowest cluster length (17.48 cm). The other studied lines and varieties listed between these two groups (Table 3).

Erbas (2012) determined the cluster length as 14.7-25.8 cm, Özgen (1993) as 23.3 cm and Nirmalakumari *et al*. (2013) as 15.01-33.23 cm. The values obtained by these researchers are closer and compatible with the values we obtained in our research. However, the average cluster length of oat genotypes was 30.60 cm (Hisir, 2009) and 22.80 cm (Yellow, 2012). These values were higher than the 19.67 cm value, we determined in our studies. The difference in panical length observed may be because of genotypes, environmental conditions, applied cultural practitices and planting times.

***Number of fertile (cluster) stems (m^{-2})*:** The difference between genotypes in terms of the number of fertile stalks per square meter was found statistically significant ($p <0.01$). In our research, the lines BDY-3 line with (450 stem/m^2) and BDY-(4400.83 stem/m^2) and BDY-1 (385 stem/m^2) were statistically non-significant with each other

and yielded the highest number of fertile stems (Table 3). The line BDY-5 had the lowest number of fertile stems (133.33 stem/m^2).

Among the varieties in our study, Diriliş got the highest value with 307.50 stem/m^2, while the lowest value was found in Seydişehir variety with 190.83 stem/m^2. Overall, the number of fertile stalks varied as 133.33-450.83 stem/m^2; while the average number of fertile stalks was 296.74 stem/m^2.

Naneli and Sakin (2017) found that the average number of fertile clusters per square meter was between 567.6 and 646.8 in their study. However, Maral (2009) determined that the average number of clusters per square meter of varieties ranged 334-506 stem/m^2. It was found that the values we recorded were lower than the values of other researchers. The difference in number of fertile stems observed may be because of genotypes, environmental conditions, applied cultural practices and planting times.

***Fertile (with cluster) stem rate (%)*:** The difference between genotypes in terms of fertile stem ratio was found to be statistically significant ($p < 0.01$). In our study, the fertile stem ratio ranged 28.22-80.57%; while the average fertile stem rate was 56.10%. Among the lines, BDY-1 and BDY-3 had the highest fertile stem rates (80.57 and 77.40%, respectively) followed by BDY-4 (66.31%).

Öztürk (1999) determined the fertile stem rate of 75.7% in his study in wheat under irrigated conditions. Although this value is close to our study but the average value was higher than 56.10%. The difference in fertile stem rate observed may be because of genotypes, environmental conditions, applied cultural practitices and planting times.

***The number of nodes in the stems*:** The variation among genotypes in terms of the number of nodes in the stem was statistically significant at the level of 1%. In our study, the number of nodes in the stem varied between 3.73 and 4.77 with an average number 4.15 (Table 4). The highest node number was recorded in lines BDY-7 (4.5) and BDY-6 (4.33). It was determined that BDY-3 line received the lowest number of nodes (3.73). Among the varieties, the highest number of nodes was found in Cheocota (4.77).

Erbaş (2012) reported 2.0-4.8 number of nodes in the main stem. Çalışkan and Koç (2019), in their study on local varieties, have observed 14 genotypes with 5-6 nodes, 61 genotypes with 6-7 nodes, 46 genotypes with 7-8 nodes, 40 genotypes with 8-9 nodes on the main stem. They further reported that they identified 3 genotypes with more than 9 nodes on main stem of the standard varieties with a range 4-8.1 and average 5.8.

The values obtained by Erbaş (2012) and our's coincided; however, the values obtained by Caliskan and Koc (2019) were higher than the values we obtained in our study. These variations may be due to environmental conditions, applied cultural processes and planting time.

***Stem thickness (mm)*:** The variation among genotypes in terms of stem thickness was statistically significant ($p < 0.01$). In the oat genotypes used in the study, statistically different groups were formed in terms of stem thickness (Table 4). The maximum stem thickness was recorded in lines BDY-5 (5.62 mm) and BDY-7 (5.33 mm). The line BDY-3 yielded the minimum stem thickness (3.68 mm). In the oat genotypes used in the study, stem thickness varied 3.68-5.62 mm, while the average stem thickness was 4.48 mm.

Erbaş (2012) determined the stem thicknesses in the range of

Table 4. Comparison of oat genotypes for forage yield under irrigated conditions.

Genotypes	S NN (No.)	ST (mm)	10S LW (g)	10S LW (g)	LW SW^{-1} (%)	CL (cm)	FLL (cm)	S NL (No.)
BDY-1	3.83fg	4.31cde	95.70cd	13.02d	14.00g	20.65b	17.55de	4.17de
BDY-2	4.00ef	3.89de	84.40de	21.86bc	26.00ab	18.10de	17.72cde	4.47bcd
BDY-3	3.73g	3.68e	68.52e	13.36d	20.00ef	18.40de	17.43de	4.07e
BDY-4	4.2cde	4.26cde	77.63de	19.88bc	26.00ab	19.33bcd	19.27bcd	4.43bcd
BDY-5	4.00ef	5.62ab	124.15ab	30.56a	25.00bc	19.37bcd	22.68ab	4.23de
BDY-6	4.33bc	4.54bcd	79.32de	19.08c	24.00bc	19.43bcd	19.73bcd	4.43bcd
BDY-7	4.50b	5.33ab	133.46a	35.06a	26.00ab	22.70a	23.90a	4.7abc
BDY-8	4.27bcd	5.10abc	107.55bc	24.56b	23.00cd	18.80cde	19.22bcd	4.63abc
BDY-9	4.20cde	4.21de	89.31cd	21.50bc	24.00bc	18.63cde	16.45de	4.77ab
Diriliş	3.93fg	4.35cde	78.44de	13.74d	18.00f	17.48e	14.63e	4.37cd
Cheocota	4.77a	4.55bcd	108.49bc	22.32bc	21.00de	22.72a	21.47abc	4.87a
Seydişehir	4.07def	3.94de	84.45de	23.23bc	27.00a	20.28bc	16.38de	4.73b
Average	4.15	4.48	94.28	21.51	23.00	19.67	18.87	4.49
CV (%)	3.80	11.26	12.00	13.20	6.77	5.03	12.08	4.62
LSD$_{(0.05)}$	0.27	0.85	19.53	4.81	0.03	1.67	3.86	0.35
	**	**	**	**	**	**	**	**

(*); P< 0.05; (**); P< 0.01; SNN: the number of node per stems; ST: stem thickness; 10 SW: 10 stem weight; 10S LW: leaves weight; 10S LW/SW: leaf stem ratio; CL: cluster (panical) length; FLL: flag leaf length; S NL: the number of leaves per stems

2.11-4.89 mm. Our result was consistent with the data of this study. Similarly, our results coincided with a range of 4.3-6.1 mm, which Narlıoğlu (2016) studied in 16 oat genotypes. Ahmad *et al*. (2008) stated that the stem thickness of oat is important with refernce to lodging and forage yield.

***10 Stem weight (g)*:** The oat genotypes were statistically significant at the level of 1% in terms of ten stem weight (Table 4). The line BDY-7 yielded the maximum (133.46 g) 10 stem weight, while the lowest (68.527 g) was recorded in line BDY-3While ten stem weights in the oat genotypes used in the study ranged 68.52-133.46 g with an average of 94.28 g.

Çeri *et al*. (2018) reported the highest single stem weight 6.06 g (60.6 g for ten sttems) and the lowest single stem weight 5.25 g (52.5 g for ten stems) in their study on 31 oat lines in 2015. Values of ten stems in our study were 68.52-133.46 g. The difference in stem weight observed may be because of genotypes, environmental conditions, applied cultural practitices and planting times.

***Leaf weight in 10 stem (g)*:** The leaf weight in ten stems of genotypes was statistically significant (p <0.01) in terms of leaf weight in ten stems (Table 4). The maximum leaf weight per 10 stem was documented in lines BDY-7 (35.06 g) and BDY-5 (30.56 g). The minimum leaf weight per 10 stem was recorded in the lines Diriliş (13.74 g) and BDY-1 (13.02 g). In the used in the study, The leaf weights in ten stems of oat genotypes ranged from 13.02 to 35.06 g with an average of 21.51 g.

***Leaf weight/stem weight ratio (%)*:** The genotypes were statistically significant (p <0.01) in terms of leaf/stem ratio (Table 4). The first group (was composed of only Seydişehir with the highest leaf/stem ratio. The line BDY-1 produced the lowest (14%) leaf/stem ratio. The overall leaf/stem ratio of the oat genotypes ranged (14-27 %) with an average of 23%.

Choudhary (2016) carried out different fertilizer and irrigation practices in 2 forage oat varieties in their study during 2011-12 growing period and found the leaf/stem ratio of (51-55 %). The difference in leaf/stem ratio observed may be because of genotypes, environmental conditions, applied cultural practices and planting times.

***Flag leaf length (cm)*:** The genotypes used in the study were found to be statistically significant (p <0.01) in terms of flag leaf length (Table 4). The genotype BDY-7 attained the maximum (23.90 cm) flag leaf length. The lowest (14.63 cm) flag leaf length was noticed in genotype Dirilis. The flag leaf length ranged 14.63-23.90 cm in oat genotypes with an average of 18.87 cm.

Narlioğlu (2016) found the flag leaf length 18.5-25.3 cm, which was consistent with our results. Çalıskan and Koç (2019) reported that the flag leaf length varied between 18.4 and 45.8 cm and their average was 28.5 cm in local varieties, and these values were higher than the average we obtained in our study. Some researchers reported that the length of the flag leaves is dependent on cultivars (Semchenko and Zobel, 2005) and the environmental conditions (Gautam *et al*., 2006; Dumlupınar *et al*., 2012). The difference in flag leaf length observed may be because of genotypes, environmental conditions, applied cultural practices and planting times.

***The number of leaves on the stem*:** The genotypes were statistically significant (p <0.01) in terms of the number of leaves on the stem (Table 4). Cheocota variety produced the maximum (4.87) number of leaves on stem among the genotypes. The genotype BDY-3 was the poorest (4.07) in terms of number of leaves on stem. Overall, the number of leaves on the stem varied 4.07-4.87 with an average of 4.49.

Molla *et al*. (2018)studies on two stated therange of number of leaves as CI-8251 (4.38) and CI-8237 (5.03). Alemu *et al*. (2007) reported the highest and lowest values of the number of leaves on the stem as 5.15 and 4.58, respectively. It was observed that the number of leaves in our study was compatible with the values obtained from other studies.

***Conclusion*:** This study was carried out to determine the oat genotypes suitable for forage to meet the early spring feed deficit and reduce the pressure on pastures. The lines BDY-7 and BDY-8 were proved promising as forage-purpose oats. Among the varieties, Seydişehir oat variety stood outlier in terms of forage yield. It is necessary to increase the yield of fodder crops to overcome quality roughage deficit, and it is one of the ways that annual forage crops should be cultivated as the second crop for the production of roughage in irrigated areas.

***Author contribution statement*:** Çeri S**:** Conceived the idea, designed the study, supervised research project and wrote the article; Çeri S**:** Research study and performed data analysis; Çeri S and Acar R**:** Field data collection and layout of experiment, reviewing and editing.

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